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TABLE OF CONTENTS

page

Introduction 1
Water Quality and Quantity 3
- Public Drinking Water Systems 3
- Wastewater Dishcarges 3
- Non-point Source Pollution 4
- Soil Conservation 5
- Hazardous Wastes 5
- Solid Wastes 6
- Wells 7
- Other Wells 7
- Reclamation of Mined Lands 8
- Emergency Response 9

Interstate Water Use 11
- Upper Mississippi River Basin Association 11
- Missouri River Basin Association 11
- Arkansas-White-Red-Basins Inter-Agency Committee 12
- Lower Mississippi River Conservation Committee 12
- Mississippi River Parkway Committee 13
- Mississippi River Basin Alliance 13

Monitor Water Quality 15
- Surface Water Quality Monitoring 16
- Monitoring Program Evaluation 17

Inventory Water Use and Availability 19
- Water Use 19
- Groundwater Availability 19
- Surface Water Availability 20

State Water Plan 21
- Background 21
- State Water Plan Volumes 22
- Surface Water Resources of Missouri 22
- Groundwater Resources of Missouri 23
- Water Quality of Missouri 23

Water Use of Missouri 24
The Hydrologic Extremes: Flooding and Drought 24
Water Resource Sharing—the Realities of Interstate Rivers 24
Missouri Water Law 24
Special Water Quality Protection Areas 25
Interagency Task Force 27
Recommendations 29

INTRODUCTION

This is the 1996 Annual Report for the Missouri Water Resources Law, as required in RSMo 640.426 (see Recommendations for citing). It provides an overview of the activities that the Missouri Department of Natural Resources (DNR) performs to meet the objectives of the law.

The report focuses upon the accomplishments of individual programs and relates program activities to those sections of the law that are addressed. The report follows the same organizational structure as the law, beginning with Water Quality and Quantity. Each section starts with text from the law, followed by a brief discussion of how the department satisfies the requirements of the law. Through an accumulation of information from different programs throughout the department, each section emphasizes the progress that has been made in implementing the Water Resources Law.

WATER QUALITY AND QUANTITY

RSMo 640.400—The department shall ensure that the quality and quantity of the water resources of the state are maintained at the highest level practicable to support present and future beneficial uses. The department shall inventory, monitor and protect the available water resources in order to maintain water quality, protect the public health, safety and general economic welfare.

PUBLIC DRINKING WATER SYSTEMS

The Department of Natural Resources (DNR) regulates approximately 1,400 community and 2,100 non-community public water systems in Missouri that serve most of the state's population. Since drinking water is a principal agent in the transmittal of communicable diseases, these systems must be routinely inspected and samples from each system must be frequently analyzed. Regulation is carried out under the authority of the Missouri Safe Drinking Water Law. Without this protection, the incidence of water borne illnesses in the state could increase.

Drinking water quality is routinely monitored by the department. The results provide early detection of potential health problems. Sampling plans are developed that match the degree of contamination threat from a source or system to the type of contaminant and frequency of testing needed. Quality assurance and quality control plans for sample collection and analysis are developed for each contaminant group. To avert public health crises related to drinking water, the data is reported to the public water systems and technical assistance staff within a short period of time.

Raw water sources vary in quality and quantity from one area of the state to another. To produce finished water of satisfactory quality and quantity on a consistent basis, treatment plants must be designed specifically for the raw water sources. Department staff review engineering plans and reports for the construction or renovation of public drinking water systems to ensure that essential sanitary standards are met. Construction permits are issued as appropriate. Department staff assure that all public water systems are properly operated and maintained and that they operate under a state permit. The permit guarantees that the public water system is operating in compliance with the law and regulations.

WASTEWATER DISCHARGES

Many agencies and organizations are closely associated with water quality issues, however, DNR is the agency responsible for maintaining and improving water quality in Missouri's streams, lakes and groundwater. It is also the agency responsible for enforcing the Missouri Clean Water Law.

Missouri water quality standards are rules made by the Missouri Clean Water Commission. The standards list the classified waters of the state, their beneficial uses, and the allowable concentrations of various pollutants.

The department requires all discharges of contaminants (other than from single family residences and many stormwater discharges) to obtain a water pollution control permit and comply with its terms.

Permits also cover point-source discharges such as treated sewage from towns, subdivisions or businesses, industrial wastewater discharges, and runoff from large, confined, animal feeding operations, mines, quarries and chemical storage areas. The permits limit the amount of pollutants that can be discharged so that water quality standards set for streams and lakes are not violated.

Letters of Approval (LOA) are required for large, confined animal feeding operations. The letters ensure that properly designed facilities are constructed for holding animal wastes. Rules have been filed that will cover procedures for the transition from Letters of Approval to permits.

The Department of Natural Resources administers a program that distributes grants or low-interest loans for the construction of wastewater treatment facilities. The funds for this program come from the state and the U.S. Environmental Protection Agency. In 1992 and 1993, this loan program dispensed in loans and grants valued at $100 million.

The loan program has been in effect since 1992 and requires that most of the burden of funding falls on cities. From 1972 to 1992, a state-federal grant program funded up to 90 percent of the construction costs of wastewater treatment facilities, which helped meet the needs of both expanding populations and replacement of aging facilities. Today, there is concern about the ability of the present funding system to continue to meet construction needs.

Enforcement actions related to water pollution are sometimes necessary. During 1993, there were about 500 active cases involving violations of the Clean Water Law or regulations. Seventy-two cases were resolved, and the facilities returned to compliance during that year. These settlements included collection by DNR and the attorney general's office of about $1.4 million for environmental damages and penalties.

NON-POINT SOURCE POLLUTION

Permits for some activities that produce non-point source pollution ensure that the waters of the state are protected against stormwater discharges coming from a wide variety of sites. These sites include coal mines, limestone quarries, clay pits, petroleum storage areas and composting sites. New regulations require construction of containment structures for businesses that store and handle bulk quantities of liquid chemicals such as petroleum, fertilizers or pesticides.

Letters of Approval or permits are currently required for Concentrated Animal Feeding Operations (CAFOs) larger than 1,000 animal units. With the exception of dairy farms, operations smaller than this may obtain a voluntary LOA. The voluntary program was developed two decades ago

and has been operated by the department as a free service to agricultural producers.

In 1995, DNR entered into an agreement with the Department of Agriculture to operate an agricultural loan program. Under this program, DNR will loan funds to the Agricultural and Small Business Development Authority (ASBDA). The ASBDA will use the funds to finance, at subsidized interest rates, animal waste facilities for producers. The loans are limited to animal feeding operations of less than 1,000 animal units. Producer's repayments are used by ASBDA to repay the loan from DNR. The department has committed $10,000,000 to these loans. Another $10,000,000 is available if the program is successful.

SOIL CONSERVATION

Top soil, in the form of sediment, can clog rivers and lakes. According to the U.S. Department of Agriculture's Natural Resource Inventory, soil erosion in Missouri was reduced by nearly 76 million tons during the period 1982 to 1992. In part, this reduction was due to the success of DNR soil conservation efforts. The department initiated over 200 projects within the "Special Area Land Treatment" program, which treats erosion problems in watersheds. The watersheds range from about 1,000 acres to 80,000 acres. Statewide, the department has provided $138 million in the form of cost share to landowners to control or prevent soil erosion.

HAZARDOUS WASTES

The department regulates hazardous waste to protect water resources and to ensure that any contamination is remediated as quickly as possible. The department oversees groundwater and surface water monitoring at hazardous waste sites within the state. As part of this supervisory oversight, hazardous waste facilities are required to determine the impact of past and present waste management practices on water quality. This includes determining the extent of contamination, distribution of contamination, and potential affect on other waters or water users.

Groundwater and surface water monitoring activities, and any subsequent remediation, can occur at four different types of facilities:

1) Resource Conservation and Recovery Act (RCRA) treatment storage and disposal facilities (TSDs),
2) Superfund clean-up facilities,
3) voluntary clean-up facilities, and
4) leaking underground storage tank facilities (LUST).

In accordance with state regulation, permitted RCRA TSD facilities whose practices might affect large bodies of surface water in Missouri must have a surface water monitoring program.

Currently, six RCRA TSD facilities in Missouri are monitoring surface water for various contaminants. These facilities report to the department at least once a year. The results are examined and tracked by the department.

In accordance with state regulation, a TSD facility that is subject to federal groundwater monitoring requirements must conduct groundwater monitoring on a regular basis until released from such obligation by the department. Currently, 36 TSD sites are conducting groundwater monitoring in Missouri. Of these 36 sites, 16 are actively remediating groundwater contamination to improve the quality of water that may ultimately migrate to surface water bodies or drinking water sources.

Each TSD facility must submit an annual groundwater monitoring report to the department for an official evaluation. The

evaluation includes determination of contaminant data trends and the extent of contamination resulting from TSD facility operations. All groundwater monitoring data from RCRA TSDs in Missouri is entered into a database where it can be tracked and evaluated.

Additional RCRA and Superfund facilities owned by the federal government are required to monitor groundwater for contamination. There are 13 federal government facilities currently required to monitor groundwater. The sites are generally operated by the U.S. departments of Defense and Energy. The Department of Natural Resources evaluates and tracks contaminant data provided by these facilities in an annual report. Currently, two facilities are actively remediating contaminated groundwater.

Additional hazardous waste sites fall under the "Superfund" law and its amendments. Superfund includes authority to initiate surface and groundwater investigations and subsequent remedial actions. The Department of Natural Resources performs site assessments on potential Superfund sites and from these assessments, determines the degree of surface and groundwater investigations that will be required.

Currently, 51 Superfund sites are undergoing some type of groundwater investigation. An additional 45 sites are performing regular groundwater and surface water monitoring. Of these sites, 19 are performing groundwater remediation. The Department of Natural Resources requires periodic reporting from these facilities. Contaminant concentrations and trends are tracked in order to recommend future courses of action.

Missouri has provided funds to staff and supervise a voluntary clean-up program for the regulated community. In 1994, the department began allowing hazardous waste facilities with confirmed subsurface contamination to implement their own voluntary cleanups. These facilities must qualify first by virtue of not fitting into the RCRA TSD category or the Superfund registry, and then must express a willingness to implement a remediation of their site by entering into a formal agreement with the department. Currently, two voluntary cleanup sites are remediating contaminated groundwater under the department's supervision.

The department regulates underground storage tanks to ensure that they are installed properly and to protect the water of the state. The department is also in charge of the Leaking Underground Storage Tank (LUST) program. The products in many leaking tanks are hazardous materials and pose a threat when released into the subsurface. Many of these tanks hold gasoline products. The goal of the LUST program is to minimize the impacts of leaking underground storage tanks on groundwater and surface water resources. Of the 1,274 confirmed active leaking tank sites in Missouri, 176 are involved in some type of groundwater monitoring and cleanup. Since many of the shallow aquifers affected by leaking tanks are connected either to drinking water sources or discharge into surface waters, the LUST program requires monitoring of the sites until they have been shown to be effectively remediated.

SOLID WASTES

Historically, landfills have been a source of surface and groundwater contamination. As of October 8, 1993, stricter federal subtitle D design and operational requirements affected all operating landfills in Missouri. Some of the new requirements relate to establishing, developing and maintaining surface and groundwater monitoring. These

include: detailed hydrogeologic investigations; installation of groundwater monitoring wells (monitored four times a year for 6 indicator parameters and twice per year for 75 parameters); and installation of a composite liner and leachate collection system on areas that were not covered by waste as of October 9, 1993.

Another change that should help protect water quality in Missouri relates to the final "cover cap" requirements. Areas already landfilled but not properly closed will require a final cover cap of at least two feet of compacted clay and one foot of soil. All areas with a geomembrane liner (an impermeable material that does not allow liquids to pass through it) require cap designs that include a geomembrane, even if the areas were previously permitted for another final cover cap design.

WELLS

All types of wells have historically been a potential point- source contamination conduit. The "Water Well Drillers Act" was passed in 1985. By the fall of 1986, rules were in place governing the construction of domestic water wells and pump installations and the plugging of abandoned wells. The drillers and pump installers were required to be permitted and their rigs were registered.

This law was passed to ensure that the quality of Missouri's groundwater is maintained at the highest level practicable to support present and future use. The importance of this law and its enforcement plays a pivotal role in the protection of our groundwater. An average of 10,000 wells are drilled each year, including those used for drinking water, monitoring, and other types of uses. If the wells are not constructed properly they may allow surface water, with its contaminant load, to bypass the earth's natural filtering system and enter directly into natural drinking water aquifers.

An important amendment to this law was passed in 1991. The amendment brought the heat pump, monitoring well, and mineral test hole drilling industries under regulation. It also created the Well Installation Board. The Board is the governing body responsible for implementation of the Water Well Drillers Act. In FY 1995, the department permitted contractors in the following areas: 598 water well, 718 pump installation, 375 monitoring well, 253 heat pump, and registered 1,273 rigs.

The existence of well construction rules (as opposed to guidance documents) greatly enhances DNR's ability to protect the groundwater of Missouri.

OTHER WELLS

The Oil and Gas Law was passed in 1965. This law requires wells used for oil and gas production, water disposal, enhanced oil recovery, and gas storage to be constructed in a manner that does not contaminate surface and groundwater resources. Approximately 4,400 wells have been permitted since 1966, with slightly more than 250 permitted since 1989 (oil and gas well construction fluctuates with the price of oil). In addition to ensuring proper well construction, the oil and gas law requires a plugging bond be placed on permitted wells. This bond is required to be maintained until the wells are properly plugged. In the event an operator improperly abandons a well, the plugging bond is forfeited and the State of Missouri, working through the Missouri Oil and Gas Council, has the authority to plug the well.

The Underground Injection Control Program is an EPA-delegated program for

which the State of Missouri has primacy. Injection wells have been divided into five classes by EPA, based upon the type of fluid injected and where it is injected in relation to underground sources of drinking water. Missouri has wells that fit into two of these classes - Class II and Class V.

Class II wells are oil- and gas-related injection wells. These wells may be used for the disposal of other fluids produced during oil extractions (mostly water) back into the producing horizon, or for enhanced recovery methods to increase production. These wells are subject to regulation under the Missouri Oil and Gas Law.

Class V wells (also called shallow injection wells) include a variety of well types that inject fluid into or above an underground source of drinking water. In Missouri, this well category includes mine backfill wells, septic systems (tank and lateral field), sinkholes improved for drainage purposes, heat pump systems, and injection wells utilized in groundwater cleanup projects. Septic systems are regulated by the Department of Health. Most other types of Class V injection wells are regulated through the Clean Water Law. The department administers the program and maintains an inventory of Class II and Class V wells.

RECLAMATION OF MINED LANDS

The Land Reclamation Commission's mission is to ensure that active mined lands are restored to a condition that supports uses equal to or better than pre-mining conditions. Active mining regulation includes permitting, inspection and enforcement activities. The minerals regulated include coal, industrial minerals (clay, barite, limestone, sand and gravel, oil shale, and tar sands) and metallic minerals (lead, iron, zinc, copper, gold, and silver).

At active coal mines, surface water quality is protected through National Pollutant Discharge Elimination System permitting. As for the protection of groundwater, coal mining companies are required, under land reclamation permits, to conduct hydrogeologic assessment prior to, during, and after mining. They evaluate any impacts to groundwater quantity or quality in the vicinity of mine sites. Mine operators are further required to mitigate any adverse effects stemming from mining activities.

For industrial minerals sites, the hydrogeologic evaluations are not required. Measures to control erosion and sediment movement off site are required. Under the Metallic Minerals Law, the three lead mining companies and the one iron ore mining company are required to provide plans and financial assurance for the continued maintenance of the mine waste sites after mining ceases. The objective is to assure that the sites are stable and not subject to wind or water erosion of the waste materials (tailings). This primarily involves a coordination role to assure that dam safety, water pollution control, air pollution control, and hazardous waste management regulatory requirements are met.

An estimated 10,000 acres at approximately 600 industrial minerals mine sites are permitted for mining. Nearly 30,000 acres at 17 coal mine sites are permitted and are either actively being mined or are in various stages of reclamation. In addition, there are five bond forfeiture sites with approximately 2,300 acres that the department now has responsibility to reclaim. These projects are in various stages of reclamation design or construction. The ten lead mine sites and one iron ore mine site permitted under the Metallic Minerals Law comprise a total of approximately 4,500 acres.

Serious health, safety, and environmental problems associated with pre-law abandoned mine lands are eliminated over time as funding becomes available through the Federal Abandoned Mine Land Program. Since 1989, several projects have been completed which have improved water quality. These areas include: Huntsville Gob II in Randolph County; Keota Gob in Macon County; Sweet Spring Creed in Randolph County; Crutchfield in Randolph County; Tebo Creek in Henry and Johnson counties; three separate Cedar Creek projects in Boone and Callaway counties; Middle River in Callaway County; and Upper Cedar Creek Watershed Reclamation in Boone and Callaway Counties.

EMERGENCY RESPONSE

The department staffs a 24-hour telephone line for reporting environmental emergencies, and maintains a unit that responds to the scene of environmental emergencies when situations warrant. Response personnel are trained to provide technical assistance concerning response, containment and cleanup of hazardous materials. In FY 95 nearly 2,000 responses to environmental emergencies were made. (ESP)

INTERSTATE WATER USE

RSMo 640.405—The department shall represent and protect the interests of the state of Missouri in all matters pertaining to interstate use of water, including the negotiation of interstate compacts and agreements, subject to the approval of the general assembly. Any department of state government affected by any compact or agreement shall be consulted prior to any final agreement.

Missouri shares the waters of its major rivers with 17 other states. In most cases other states and Indian tribes can use water from these rivers before they reach Missouri. Also, federal agencies manages much of this water. To make sure that Missouri's interests are considered, the department represents the state of Missouri in the following river basin associations:

UPPER MISSISSIPPI RIVER BASIN ASSOCIATION

The Upper Mississippi River Basin Association (UMRBA) is made up of representatives of Missouri, Wisconsin, Minnesota, Iowa and Illinois. Governor Carnahan appointed David Shorr, director of DNR, as Missouri's representative in UMRBA.

The Association developed a master plan to balance economic development with environmental improvement on the upper Mississippi River. UMRBA works through Congress and the states to carry out provisions in the master plan, and pursues a legislative agenda as agreed upon by the board members. The Association also serves in an oversight or review capacity for the ongoing Mississippi River Navigation Study to improve river transportation with attention given to environmental concerns. The Association has been very successful at bringing in federal funding to enhance the Mississippi River.

MISSOURI RIVER BASIN ASSOCIATION

Membership of the Missouri River Basin Association (MRBA) includes Missouri, Kansas, Iowa, Nebraska, North Dakota, Montana, and Wyoming, plus one member representing Indian tribes. Governor Carnahan appointed David Shorr, director of DNR, as Missouri's representative in MRBA. South Dakota recently withdrew from MRBA. The Association is currently working with the U.S. Army Corps of Engineers on revising the Master Water Control Manual for the Missouri River. It also pursues a legislative agenda as agreed upon by its Board of Directors, and provides a forum for the discussion of contemporary water resource issues in the basin, such as tribal water rights, river management, agricultur-

al issues, and endangered species.

For the past seven years, the states of the Missouri River basin have been embroiled in controversy over how the river should be managed. The disagreement, brought on by severe and persistent drought that began about 1988 and ended with the Great Flood of '93, focuses on the requirements embodied in the Missouri River Master Water Control Manual. This document, familiarly called the "Master Manual," guides the Corps' Reservoir Control Center in Omaha. The Control Center operates the system of dams and reservoirs that enable management of the river's flow.

The Master Manual was written to direct the Corps' administration of the Water Development Act of 1944, which authorized construction of the dams and directed the Corps to provide benefits as specified in the legislation. As long as rainfall in the basin was normal or above, there was little disagreement between the states of the upper basin and those of the lower river. However, the system was not severely tested by drought until reservoirs began to be drawn down in response to the six-year drought that began in the late 1980s.

The crux of the disagreement is fundamental. Upper basin states contend that reservoir levels ought to be held at high levels—even in drought—to protect the recreational industry that has developed around the six large lakes on the upper river. The downstream states view this position with considerable alarm, because it would deny them the use of a significant share of the water stored in the reservoirs.

In effect, if the upstream states were to be successful in changing the management strategy to meet their demands, it would completely compromise the purposes for which the system was designed and built. The design objectives for the system were to store water in wet seasons, and release it in dry seasons, to provide flood control, navigation, water supply, power generation, irrigation water, and fish and wildlife benefits throughout even the most severe droughts.

ARKANSAS-WHITE-RED BASINS INTER-AGENCY COMMITTEE

The Arkansas-White-Red Basins Inter-Agency Committee (AWRBIAC) includes representatives from the states of Missouri, Arkansas, Louisiana, Texas, Oklahoma, Kansas and New Mexico. Governor Carnahan appointed David Shorr, director of DNR, as Missouri's representative in AWRBIAC. Federal agencies in AWRBIAC include Dept. of the Interior, U.S. Geological Survey, Bureau of Reclamation, National Oceanic and Atmospheric Agency, Federal Emergency Management Agency, U.S. Army Corps of Engineers, and Natural Resources Conservation Service.

The committee exists primarily for coordination and communication purposes. Administration and hosting of meetings are rotated among both state and federal members. The primary activity of interest to Missouri is the development of a revised operating plan for the White River, which includes Table Rock Dam, Clearwater Dam, and part of Lake Norfork in Missouri. Also of interest is the development of abatement measures and methodology to improve dissolved oxygen content of tailwaters of White River dams. (WRP)

LOWER MISSISSIPPI RIVER CONSERVATION COMMITTEE

The Lower Mississippi River Conservation Committee (LMRCC) has membership which includes the states of Missouri, Tennessee, Kentucky, Arkansas, Louisiana and Mississippi. Federal agencies represented

include the U.S. Army Corps of Engineers, Environmental Protection Agency, U.S. Geological Survey, Natural Resources Conservation Service and U.S. Fish & Wildlife Service.

The LMRCC is a relatively new organization and differs from other basin associations by including both fish and wildlife agencies as well as environmental regulatory agencies. The LMRCC has several operating committees that deal with specific subsets of lower Mississippi interests, such as fish and wildlife and water quality.

MISSISSIPPI RIVER PARKWAY COMMISSION

The membership of the Mississippi River Parkway Commission (MRPC) includes all states of the Mississippi River main stem, plus various other agencies and interest groups. The MRPC is primarily a tourism-driven organization. Its major thrust is directed toward improving opportunities for tourism growth along the Mississippi River corridor from New Orleans to St. Paul.

MISSISSIPPI RIVER BASIN ALLIANCE

The Mississippi River Basin Alliance (MRBA) includes both individual and agency/corporate memberships. It is a new organization that focuses on environmental issues throughout the Mississippi River basin. Various committees focus their energies on issues of current importance, such as environmental justice, non-point source pollution, legislative agenda, and monitoring federal initiatives.

MONITOR WATER QUALITY

RSMo 640.409 calls for the department to establish, develop and maintain an ongoing statewide surface and groundwater monitoring program, the purposes of which are the following: 1) determination of ambient surface and groundwater quality for use as background or baseline water quality data; 2) detection of trends in the character and concentration of contaminants in surface and groundwater resources; and 3) identification of areas highly vulnerable to contamination.

The Department of Natural Resources conducts an extensive monitoring program for chemicals in public drinking water systems. In FY 95, approximately 3,140 public water supplies were tested, with over 36,520 samples analyzed. This effort covers both surface and groundwater sources.

While the tests are normally performed on "finished" water after treatment, the results tell us something about raw water quality since few public water systems provide treatment that would remove chemical contaminants. A part of the monitoring plan is a vulnerability assessment performed to support the "waiver of monitoring" requirements. This indicates various threats to specific public water supplies and allows that information to be considered in establishing monitoring requirements.

The department studies the recharge areas of springs, and delineates losing streams and sinkholes to determine areas where groundwater is particularly prone to contamination. Harmless fluorescent dyes are used to trace the movement of groundwater from its recharge area to its discharge point.

Since 1989, the department has performed numerous water traces in karst areas where groundwater resources can easily become contaminated by surface activities. In karst areas, much surface water is channelled underground in losing streams and sinkholes. The water lost to the subsurface typically resurfaces, sometimes as far as 40 miles away, at a spring or springs. Water wells between the recharge point and the receiving spring can be affected by contaminants entering losing streams and sinkholes.

The results of individual dye traces are stored in the department's Dye Trace Data Base. Since 1989, several reports have been published that describe in-depth studies of several major spring systems (Hydrogeology of the Bennett Spring Area, Laclede, Dallas, Webster, and Wright Counties, Missouri [WR-38], Hydrogeology of the Maramec Spring Area [in preparation]).

The Water Well Drillers Law requires that all persons engaged in water tracing register with the department and renew the registration annually. All proposed injections must be reported to the department's

Division of Geology and Land Survey prior to injection of dye, and written and graphical documentation of traces is provided to the department within 30 days after completion of each trace. The information will be provided to interested parties upon request at cost of reproduction. For the trace to be included in the department's dye trace data base, the data must examined by a three-member Dye Trace Committee. If the data quality and documentation is satisfactory, then the results are entered into the department dye trace data base.

Compliance monitoring is performed to test wastewater from facilities with National Pollutant Discharge Elimination System (NPDES) state operating permits. In FY 95, over 1,000 analyses were performed to determine compliance with the Clean Water Law, state regulations, the operating permit and the NPDES permit.

The department performs a variety of water- and sediment-quality investigations each year in the form of complaint investigations, wasteload allocations, ecological risk assessments, and fish tissue contaminant monitoring. Department biologists are currently developing aquatic macroinvertebrate-based "biocriteria" for assessing stream quality in each eco-region of the state. These criteria will eventually be incorporated into the state water quality standards.

Due to the Flood of 1993, a federally-funded sanitary landfill monitoring project for flood damaged sanitary landfills was implemented. Effects of the flood included periods of surface ponding, soil saturation, an elevated groundwater table and increased velocity in the subsurface movement of water. The department received equipment and training to monitor landfills that operated before and after the flood to determine if any surface or groundwater contamination occurred. This project is currently underway but results are not expected until late FY 96.

SURFACE WATER QUALITY MONITORING

The major purposes of the water quality monitoring program are to (1) characterize "background" or "reference" water quality conditions, (2) better understand flow event, and diurnal and seasonal water quality variation and its underlying processes, (3) characterize aquatic biological communities and habitats, and distinguish between the impacts of water and habitat quality, (4) assess time trends in water quality, (5) characterize specific and regional impacts of point and non-point source discharges on water quality and, (6) to check for compliance with water quality standards or wastewater permit limits.

All of these objectives are statewide in scope. Reference conditions of water chemistry and of aquatic macroinvertebrates have been or are being used to develop water quality standards. Due to the cost of environmental monitoring, the department routinely coordinates it's monitoring activities with other state and federal agencies.

The strategy for monitoring varies by the waters being sampled. Many water quality monitoring strategies exist including monitoring effluent discharges, monitoring the impacts of discharges upon localized surface waters, monitoring extended impacts from effluent sources, and conducting surveys of "background" conditions. The monitoring activities through which these strategies are implemented take several forms:

1.) Fixed station chemical monitoring networks
2.) Intensive surveys

3.) Special topic monitoring (fish kill investigations, bacterial monitoring, contaminant transport studies, etc.)
4.) Toxics monitoring
5.) Biological monitoring (of aquatic macroinvertebrates)
6.) Fish tissue, sediment, and shellfish monitoring.

MONITORING PROGRAM EVALUATION

The water quality monitoring program within the department evolved as a program to characterize and cope with point source wastewater discharges. This program, which has stressed chemical monitoring, appears to have been successful.

During the next two years, the department plans to re-evaluate the present water quality monitoring plan and will probably change the plan in the following ways: (1) reduce the size of the fixed-station chemical network, (2) increase the amount of intensive chemical and biological water quality studies, focusing on specific pollution sources, (3) develop an assessment protocol for aquatic habitat quality, and (4) increase the amount of aquatic invertebrate sampling statewide toward the development of biocriteria within our water quality standards.

The major reasons for these changes are the perception that: (1) more large municipal or industrial wastewater discharges need substantial water quality study to fully understand their impacts on receiving waters than the department is presently able to conduct, (2) biological criteria may be better than conventional chemical monitoring for characterizing many non-point pollution sources, (3) many problems in streams are not due to water chemistry problems, but to physical problems in the stream channel, in the riparian zone, or further up in the watershed.

The biggest challenge will be to find a way to assess the water quality impact of thousands of confined animal feeding operations across the state. To date the Department of Natural Resources and the Department of Conservation have been able to investigate and document at least a portion of all discharges that have caused fish kills, but no monitoring program has ever tried to assess the day-to-day subacute impacts of these pollution sources, which may be significant.

INVENTORY WATER USE AND AVAILABILITY

RSMo 640.412—The department shall maintain an inventory on ground and surface water uses, quantity and users.—The department shall inventory the following: 1) existing surface and groundwater uses; 2) quantity of surface and groundwater available for uses in the future; 3) and water extraction and use patterns.

WATER USE

As part of the Major Water Users Law (RSMo 256.400), the department compiles water use information. Major water users are defined as those users that are capable of pumping greater than 100,000 gallons per day from either groundwater or surface water. There are 1,846 users registered. There is no penalty for failing to report. Most likely, there are many major water users that do not report. The Major Water User Database includes information about location, amount of water used and type of use (domestic, municipal, irrigation, recreation, industrial, electrical generation, fish and wildlife, and drainage.)

Public drinking water systems are significant users of both surface and groundwater. The Census of Missouri Public Water Systems, published by the department, provides many details about water use by public water systems. It includes the water source, the production capacity and average daily consumption, the location of surface water intakes, and the number of customers served. Today, there are 1,400 public water systems serving cities, water districts, subdivisions, trailer parks, and institutions. Almost 5 million citizens of Missouri use public water systems as their source of water. The total production capacity of our community water systems is 2,579.5 million gallons daily (MGD), with an average consumption of 1,146 MGD.

GROUNDWATER AVAILABILITY

Most cities in southern Missouri rely on groundwater for all of their water-supply needs. The department is sometimes called upon to determine if the amount of water being used is causing long-term water level changes in aquifers, or causing water quality changes. The results of some of these studies have been published (i.e. A Hydrologic Analysis of the Ozark Aquifer in the Rolla Area [WR-42], Hydrogeologic Investigation of the Fulbright Area, Greene County, Missouri [WR-43]).

The department operates and maintains a network of approximately 50 groundwater-level observation wells throughout the state that are equipped with automatic recorders. The recorders measure and

record the distance from land surface to the water level in the well. Water levels in the wells change in response to changes in natural conditions. Precipitation will generally cause a decrease in the depth-to-water in shallow wells. During extended periods of dry weather, depth-to-water in most wells increases as water drains from the aquifer through springs and streams. Water levels also change in response to pumping. The observation well network is used to monitor the quantity of water available from particular aquifers across the state.

The data from the observation well network is processed and published in an annual report (currently available through Water Year 1993). The data reports contain the average daily water level for each station, a graphic representation of the data, and daily precipitation from the nearest National Weather Service recording station.

SURFACE WATER AVAILABILITY

The department is a cooperator in the U.S. Geological Survey program which collects and publishes water data for Missouri's surface and groundwater resources. Substantial amounts of surface and groundwater information have been collected through this effort, and published annually in a report series entitled Water Resources Data—Missouri. Records have been collected in this manner for nearly 75 years. The scope of data collection efforts has widened to include surface and groundwater quality information. Presently, the stream gaging network monitors flow and stage at 114 stations, and monitors surface water quality at 54 sites statewide. Water quality stations include physical, chemical, and biological parameters such as water temperatures, specific conductance, dissolved oxygen, pH, carbonate, bicarbonate, alkalinity, inorganic constituents, nutrients, trace elements, indicator bacteria, sediment, and pesticides.

The department maintains two databases on dams in the state. The STATUS database contains only those dams that are regulated in accordance with Chapter 236 of the Revised Statutes of Missouri. This includes dams that are 35 feet or more in height as measured from the crest to the downstream toe of the dam. The number of dams currently included in this database is 600. The database includes spatial and physical data, downstream hazard ratios, ownership information, and the current regulatory status of each dam.

The NATDAM database is maintained through a continuing contract with the Federal Emergency Management Agency (FEMA) and the Association of State Dam Safety Officials. This database includes dams that meet the height and storage criteria established by FEMA and are identical to the criteria established by the U.S. Army Corps of Engineers for the original national inventory compiled in the 1970s. Dams which are 25 feet or more in height with a storage volume of at least 15 acre-feet, or which are 6 feet or more in height with a storage volume of at least 50 acre-feet, are included in this inventory. The number of dams currently inventoried in this database is 4,004. The database includes spatial and physical data, downstream hazard rating, ownership information and purpose of the dam.

STATE WATER PLAN

640.415—1.The department shall develop, maintain and periodically update a state water plan for a long-range, comprehensive statewide program for the use of surface water and groundwater resources of the state, including existing and future need for drinking water supplies, agriculture, industry, recreation, environmental protection and related needs. This plan shall be known as the "State Water Resources Plan."

2. The department shall establish procedures to ensure public participation in the development and revision of the state water plan.

3. The department shall submit a report to the general assembly at least one year prior to the submission of the state water resources plan, and may recommend any statutory revision which may be necessary to implement the requirements of this section. The plan shall be submitted to the general assembly for approval or disapproval by concurrent resolution.

BACKGROUND

Since 1989, when the Water Resources Law was passed by the Legislature, DNR has undertaken activities to address and fulfill the requirements set forth in RSMo 640.415. Specifically, these activities include public participation, issue identification, needs assessment, resource inventory, and multilevel planning and coordination.

DNR has sought public input through the use of various forums which have included statewide public meetings and conferences, regional meetings and stakeholder meetings. This effort has included the Missouri Rural Opportunities Council (which is composed of various private groups as well as state and federal agencies), Regional Planning Commissions, the Water Quality Coordinating Committee, the Missouri Irrigators Association, Missouri Association of Counties, the Clean Water Commission, Distributive Educational Clubs of America, DNR sponsored "Open Houses," the Small Watershed Program Conference, Ozark Scenic Riverways Association, and the Missouri Municipal League. These public input forums serve to: support, enrich and further define the water resource issues first defined in 1990; identify new issues; and inform and educate the public on the broader, and often interrelated, water resource planning issues.

An example of this is the joint effort by the Department of Economic Development, Regional Planning Commissions and DNR. A series of 18 meetings were held throughout the state to solicit public comment on the issues, problems and needs associated with rural water supply. This effort resulted

in a set of recommendations which will improve rural water supply development funding if implemented.

Another very successful public participation activity was related to the issues surrounding the interstate flow and use of the Missouri River. A series of four conferences were held across the state to bring together a Missouri River constituency. These conferences not only provided an informational forum for Missouri citizens and businesses but attracted attendees from as far as Montana and Louisiana. The meetings served the heighten awareness of the issues and to identify the needs of the people of the state concerning the operation of the Missouri River.

Following the passage of the 1989 Water Resource Law, DNR prepared the 1990 Pre-Annual Status Report. This report provided the initial step in issue identification and needs assessment by listing fifty-two water resource issues facing the state and its citizens. The issues were divided into five categories: water management, water conservation, water quality, water development, and research/studies. Additionally, each identified issue was prioritized as: a) requiring immediate action due to its impact on public health, the environment or economic prosperity, b) important issues requiring study and attention, or c) long-term water resource issues which require data and/or extensive evaluation and analysis.

Through a coordination and planning effort, the issue of drought was addressed; resulting in the development of the Missouri Drought Response Plan. This plan was prepared by DNR with the cooperation and support of the Missouri Departments of Agriculture, Public Safety, Health, Conservation, Economic Development, the University of Missouri-Columbia and others. This plan establishes processes for drought monitoring, and coordinated advanced planning and response. It complements and supports the State Consolidated Plan and the State Emergency Operations Plan. Its basic purpose is to lessen the negative impact of drought on Missouri citizens through coordinated resources management and response.

STATE WATER PLAN VOLUMES

The department is developing a series of technical documents to provide basic information about Missouri's surface water, groundwater, water use, water quality, interstate issues, hydrologic extremes and water law. These volumes will assist in focusing the development of the Missouri State Water Plan. They will serve to support and compliment public participation, issue identification, needs assessment, and multi-level planning coordination. When these volumes are completed, the department will work with groups and individuals across the State to gather input on a regional and watershed basis for the development of the State Water Plan. The Interagency Task Force will also have input into the State Water Plan before it is finalized and submitted to the governor and General Assembly.

The seven volumes are planned for release within the next year. The purpose and proposed contents of each of the volumes are discussed in the following paragraphs.

SURFACE WATER RESOURCES OF MISSOURI

This volume will contain a basin-by-basin assessment of Missouri's surface water resources. In the report, basins will be grouped into 1) Upper Mississippi River Tributaries, 2) Missouri River tributaries

north of the river, 3) Missouri River tributaries south of the river, 4) lower Mississippi River tributaries, 5) White River tributaries, and 6) Arkansas River tributaries.

It will characterize the current surface water resources within the state so that comparisons and evaluations can be prepared from one basin to the next. Text and illustrations in the report will describe water budget information (precipitation, evapotranspiration, total yield, surface water runoff), long-term flow data for major rivers, flow-duration curves, runoff volumes, draft-storage relations for different areas, baseline natural water quality, and brief statements on major water quality problems. The close relationship between quality, recharge, and discharge of groundwater and surface water in the Ozarks will be discussed. River discharge hydrographs for years of lowest and highest flows will be included for many basins. Streams that are used as public water supplies will be identified. Volume and surface area information for major reservoirs, such as the Corps of Engineers impoundments, major private reservoirs such as Lake of the Ozarks, and other reservoirs that are used for public water supply will be included in the report. In addition, reservoirs owned by the Department of Conservation and Department of Natural Resources will be listed.

GROUNDWATER RESOURCES OF MISSOURI

This volume will present a detailed statewide assessment of the groundwater resources of Missouri. It will provide information concerning the availability and natural quality of groundwater throughout the state. With this report, users will be able to determine if groundwater in a particular province will supply the quantity and quality of water necessary to meet a particular purpose. Additionally, the report will be useful in helping to protect groundwater resources from degradation.

Unlike surface water, it is inappropriate to discuss groundwater resources based on surface watersheds. For this report, Missouri has been subdivided into seven groundwater provinces whose boundaries were established using geologic and groundwater-quality criteria. The provinces are: A) the Ozarks (Salem Plateau); B) Springfield Plateau; C) Southeastern Missouri (Bootheel), Mississippi River alluvium, Missouri River alluvium; D) St. Francois Mountains; E) northwestern Missouri; F) northeastern Missouri, and G) the Osage Plains of west-central Missouri. The geology, aquifer characteristics, groundwater availability, and general quality of groundwater in the seven groundwater provinces will be presented in this report. The report will also include information on groundwater development, well construction criteria, groundwater contamination potential, fluctuations and trends of groundwater levels, aquifer volumes, and groundwater recharge and storage.

WATER QUALITY OF MISSOURI

This volume will focus on the current quality of Missouri's surface water and groundwater. The volume will look at chemical, bacteriological, and radiological quality of water, natural and man-induced water-quality changes, and the effects of waste disposal on water. It will serve as a valuable reference for anyone seeking water quality information whether for resource development or resource protection.

Data collected by various programs in DNR, the Department of Health, the De-

partment of Conservation, and the U.S. Geological Survey will be used to depict the current state of Missouri water quality, and delineate areas of water-quality problems.

WATER USE OF MISSOURI

This volume will present currently available water use information for Missouri's ground- and surface-water resources. Water use information from a variety of sources will describe private and public water supply, industrial water use, agricultural water use, electrical power production, navigation needs, recreation needs, fish and wildlife needs. Descriptions of water uses will include withdrawal quantities and locations of registered major water users for selected categories, along with discussions of usage "needs." Withdrawals will be summarized by category, county and eight-digit hydrologic unit. Instream flow will also be discussed.

THE HYDROLOGIC EXTREMES: FLOODING AND DROUGHT

Both droughts and floods are important topics in water planning. This volume will provide basic information about drought and flood, specific to Missouri. A historical perspective will be given as well as information that can be used in the planning and design of water-related facilities. It will describe concepts and terminology that are helpful in understanding droughts and floods.

WATER RESOURCE SHARING— THE REALITIES OF INTERSTATE RIVERS

Missouri is the furthest state downstream on the Missouri River. It's in the middle section of the Mississippi River, and an upstream state on the Arkansas and White rivers. Because of its location, Missouri can be greatly affected by activities and water policy in the upper basin states of the Missouri- and Mississippi-river basins. Missouri policy can also affect downstream states on the Mississippi, Arkansas and White rivers. Many serious issues affecting these rivers have less to do with their physical characteristics than with political, economic, and social trends. The issues affecting the Missouri, Mississippi, White, and Arkansas rivers are very complex, and their potential impact on Missouri is so great that a detailed presentation of Missouri's views and policy concerning these great rivers is necessary and will be presented in this volume.

MISSOURI WATER LAW

This volume will provide an overview of Missouri Water Law. Previous publications on Missouri Water Law were completed by T. E. Lauer in 1964 and 1969, and updated by Peter Davis and James Cunningham in 1977. Sufficient changes have occurred in the field of environmental law and regulation since 1977 to warrant the drafting of a new publication covering the topic.

Legal restrictions and requirements on how we manage, use, and protect our water resources serve to balance individual rights with the needs of society. Water law is an integral part of the larger realm of water resources management. Public health, public safety, and the economic well-being of the state and its people depend on adequate availability of quality water.

SPECIAL WATER QUALITY PROTECTION AREAS

640.418 Special water protection area, procedure to establish.—1. The department may establish special water quality protection areas where it finds a contaminant in a public water system in concentration which exceeds a maximum contaminant level established by the environmental protection agency pursuant to the Safe Drinking Water Act, as amended, or a maximum contaminant level established by the department pursuant to this chapter or sections 640.400 to 640.435 or a contaminant in surface or groundwater which exceeds water quality standards established pursuant to chapter 644, RSMo, which presents a threat to public health or the environment. In making such a determination, the department shall consider the probable effect of the contaminant or contaminants on human health and the environment, the probable duration of the elevated levels of the contaminant, the quality, quantity and probable uses of surface or groundwater within the area, and whether protective measures are likely to prevent, mitigate or minimize the level of the contaminant in the surface or groundwater.

2. If the department determines that a special water quality protection area should be established, it shall consult with the interagency task force and with the public water system or systems affected and determine the boundaries of such area. When the boundaries of any such areas have been determined, the department shall, after a public hearing, issue an order designating the area as a special water quality protection area. Such an order shall include a geographic, hydrologic and stratigraphic definition of the area.

3. The department shall hold a public hearing or a public meeting within the area under consideration for designation as a special water quality protection area. The department shall notify every city and county within the proposed area and shall notify the public by press release and by publication of a notice in a newspaper of general circulation in the region.

640.420 Special water protection area, information program to be established, purpose, duties.—When a special water quality protection area has been established, the department shall implement an area informational program to help prevent, eliminate, mitigate or minimize the continued introduction of the contaminant or contaminants into the surface or groundwater.

640.423 Designation as protection area removed, when.—The department shall determine when the level of a contaminant or contaminants in a special water quality protection area does not exceed, and are

not likely to exceed, the water quality standards established pursuant to sections 640.400 to 640.435 and this chapter 644, RSMo. Upon such determination, the designation of an area as a special water quality protection area pursuant to section 192.300, RSMo, sections 640.100, 640.120, and 640.400 to 640.435 shall be removed.

INTERAGENCY TASK FORCE

640.430—Interagency task force established, members, meetings.—1. The department shall establish an interagency task force consisting of the departments of health, conservation, agriculture, the University of Missouri College of Agriculture, and other such departments and agencies as may be necessary to effectuate the purposes and provisions of sections 640.400 to 640.435.

2. The interagency task force shall meet at least semi-annually. The department shall be the lead agency in matters related to surface and groundwater protection.

There has been a transition from formal meetings of the Interagency Task Force, which covered generalized topics, to informal coordination, which address more specific topics. This coordination is ongoing with the agencies represented on the Task Force. To effectuate the law, the department will continue to call on the agencies representing the Task Force. If necessary, this may include a transition back to formal meetings.

RECOMMENDATIONS

640.426 The department shall prepare and submit to the general assembly and the governor an annual report which details the progress it has made in meeting the objectives of sections 640.400 to 640.435 and which contains recommendations in furtherance of the purpose and provisions of sections 640.00 to 640.435.

This 1996 Annual Report highlights some of the activities conducted by the department that either fall under or are closely related to the Missouri Water Resources Law. It demonstrates the breadth of activities that the department conducts and the progress that has been made in meeting the objectives of the Water Resources Law. This report is not a comprehensive listing of the department's water related activities.

The department continues to evaluate how to best meet the State's water quality and quantity needs and will submit recommendations on the furtherance of the Water Resources Law where appropriate.